Communications Dashboard (Control Rooms, Take a Cue from Facebook®!) Chapter 1

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Abstract— **Papers published via IEEE and AIAA conferences have presented an overview of how social media could benefit NASA working environments in general [1] and proposed three specific social applications to benefit space flight control operations [2]. One of them, Communications Dashboard, would help a real time flight controller keep up with both the "big picture" and significant details of operations via a cohesive interface similar to those of social networking services (SNS). Instead of recreational social features, "CommDash" would support functions like console logging, categorized and threaded text chat streams with enhanced accountability and graphics display features, high-level status displays driven by telemetry or other events, and an on-screen hailing function for requesting voice or text stream conversation. Moving certain voice conversations to text streams would reduce confusion and stress in two ways. Within text conversations, there would be far less repetition of content since text conversations have visual persistence and are reviewable instantly, e.g., there's no need to brief new participants to a discussion – they just read what's already there. Remaining voice traffic would stand out more clearly, and quieter voice loops means fewer "say again" calls and less distraction from visual and mental tasks, thus less stress. (Most flight controllers monitor 4 or 5 voice loops at once.) Links could be created from console log entries to chat selections so that underlying details are readily available yet unobtrusive. This would reduce the confusion that rises from having multiple and sometimes divergent copies of the same information due to cut/copy and paste operations, attachments, and asynchronous editing. This concept could apply to a plethora of real time control environments and to other settings with lots of information juggling. This paper explores the dashboard concept in further detail and chronicles the first phase of a NASA IT Labs (Information Technology) project that could lead to a working system.** [1]

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1. INTRODUCTION

The heart of International Space Station (ISS) flight operations control involves a) communicating effectively in real time with other controllers in the room and/or in remote locations and b) tracking significant events, decisions, and rationale to support the next set of decisions, provide a thorough shift handover, and troubleshoot/improve operations. ISS flight controllers speak with each other via multiple voice circuits or "loops," each with a particular purpose and constituency. Controllers monitor and/or respond to several loops concurrently. The primary tracking tools are console logs, traditionally kept by a single operator and not visible to others in real-time. Information from telemetry, commanding, and planning systems also plays into decision-making. Email is very secondary/tertiary due to timing and archival considerations and the ease with which content can be misplaced or deleted. Voice communications and log entries supporting ISS operations have increased by orders of magnitude because the number of control centers, flight crew, and payload operations have grown. A flight controller's "juggling capacity" can be saturated by excessive voice traffic and/or demands from other systems, especially during high tempo operations when saturation is least affordable.

While gathering software requirements for a web-based console logging application to support ISS payload operations at Marshall Space Flight Center's (MSFC) Payload Operations Integration Center (POIC), the author noted that text and attachments are often replicated among several systems and that much voice traffic involved coordination of sending and receiving legacy type communications. He also observed that Facebook® and other SNSs do an amazing job of a) integrating information and processes relevant to their intended audiences and purposes and b) helping users spend much more time engaging with message content than fighting the addressing and indexing scheme. From there, it was a short jump to the question, "Why not harness the same kind of streamlining power to operations?" The follow-on question, "How could we do this?" led to the Communications Dashboard concept.

Throughout this paper, "Communications Dashboard" will frequently be abbreviated as "CommDash".

Before delving into the technical particulars of CommDash,

let's look at the project environment in which it's being developed, and some fundamental characteristics of social media and how information is transmitted among humans.

2. NASA IT Labs Project Description

In July of 2012, the author received approval and funding to pursue development of a Communications Dashboard via the "IT Labs" (Information Technology) program sponsored by NASA's Chief Technology Officer (CTO), with the effort beginning in September 2012. The IT Labs approach involves a sequence of 90-to-120 day phases managed by update-evaluate-approve-perform-evaluate-decide cycles. Each phase is eligible for up to approximately $30K of procurement funds. Figure 1 illustrates the IT Labs project flow:

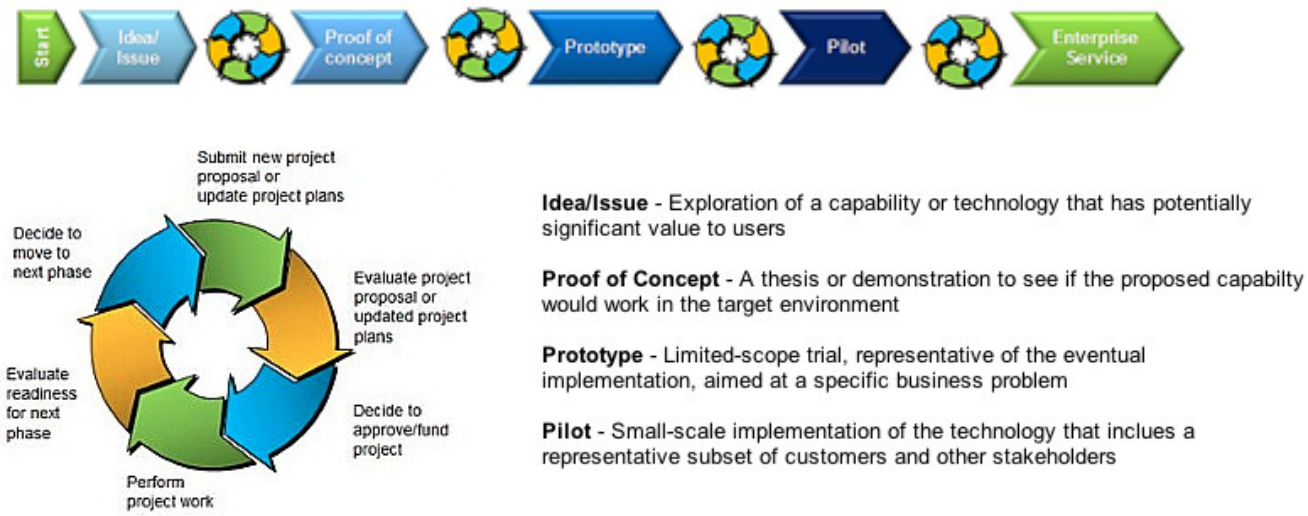

Figure 1 – NASA IT Labs Project Flow

The IT Labs application process requires submitting a video of a one-minute "elevator pitch" outlining the project. The pitch for CommDash is viewable online at http://av.ndc.nasa.gov/content/download2.php?video=DaveScottCommunications . One might find it helpful to pause the video at various points to ponder slide contents.

The CommDash project's primary goal is to build a software test bed to explore unconventional integration, presentation, and exchange of flight control communications in intra-center and/or inter-center contexts. The ultimate goal is to create a unified interface for multiple communication tools to complement and/or augment voice loop discussions. This would enable flight controllers to manage more operations with fewer spoken and written words and with greatly reduced stress.

Secondary results might include a) new SNS methods and/or unique mash-ups of existing techniques and b) techniques that could apply to a wide variety of control and design environments.

The approach to the Idea/Issue phase is:

- Seek flight control facility developers at other NASA centers and perhaps a few other agencies. Look for similar interests and concerns. Evolve ideas on what capabilities to strive for in the testbed.
- Identify and assess COTS/Open Source component potential for creating the types of features envisioned in the elevator pitch.
- Develop preliminary ideas on how existing flight control applications at MSFC's HOSC could provide selected data for presentation in a Comm Dashboard.
- Define a target scope and extent for the Proof of Concept phase effort.

NASA IT Labs provides a Sharepoint®-based management and collaboration web site to each project. These are accessible by those with regular or VPN access to the NASA institutional network. CommDash's site is at https://labs.nasa.gov/Communication_Dashboard .

While NASA personnel supporting this effort clearly have access, many of the information and expertise sources that can make CommDash a reality lie outside the NASA network. This barrier turned out to be benevolent in nature, as it prompted the author to practice what he preaches about using social media in the workplace. (Segue to next section!)

3. COLLABORATIVE PATHS

The IT Labs program provides a well-organized web page for each project, with flexible layout options that the PI/project manager can exercise. Sections include project status, milestones, calendar, discussions with sponsors/management, links, document library, and discussions among participants. The last two sections presented a challenge in that some members of the the team, which includes representatives from multiple NASA field centers, Commercial Off The Shelf (COTS) vendors, and Open Source software providers, cannot access the NASA network.

As it happens, the author had established a Wiki for follow-on discussions related to the SpaceOps 2012 paper [2] that discussed CommDash and two other ways to simplify control room communications. This presented an opportunity to feed two birds with one crumb. By hosting discussions on the "Simplify Ops Comm" wiki, current CommDash participants could interact with one another and those following the wiki courtesy of SpaceOps or other referrals might become interested and join the team. "Discoverability" is a key attribute of Web 2.0 and social media [1].

The now-traditional practice of collaboration via emailing, posting, downloading, and uploading document files was a big improvement over circulating paper, especially where distance was an issue, and has also created tremendous file proliferation problems, just as cutting and pasting among console logs, planning systems, and the like has cluttered the operations world. NASA recently extended their pilot of Google Apps for NASA, which stores NASA-originated files in a government cloud yet allows easy access by invited internal or external parties. Storing CommDash documents there, then publishing links to these Docs on the IT Labs CommDash site and the Simplify Ops Com wiki means there is one copy for all to share. Additional productivity and clarity comes from Google Docs' collaborative editing capability (simultaneous and asynchronous collaborative commenting and editing per document owner's assignment).

Figure 2 shows the "triple play" structure intended for CommDash collaboration. Due to discoveries made shortly before publication deadline, changes are in work to host the public-facing forum via Google Apps for NASA instead of wikispaces.com.

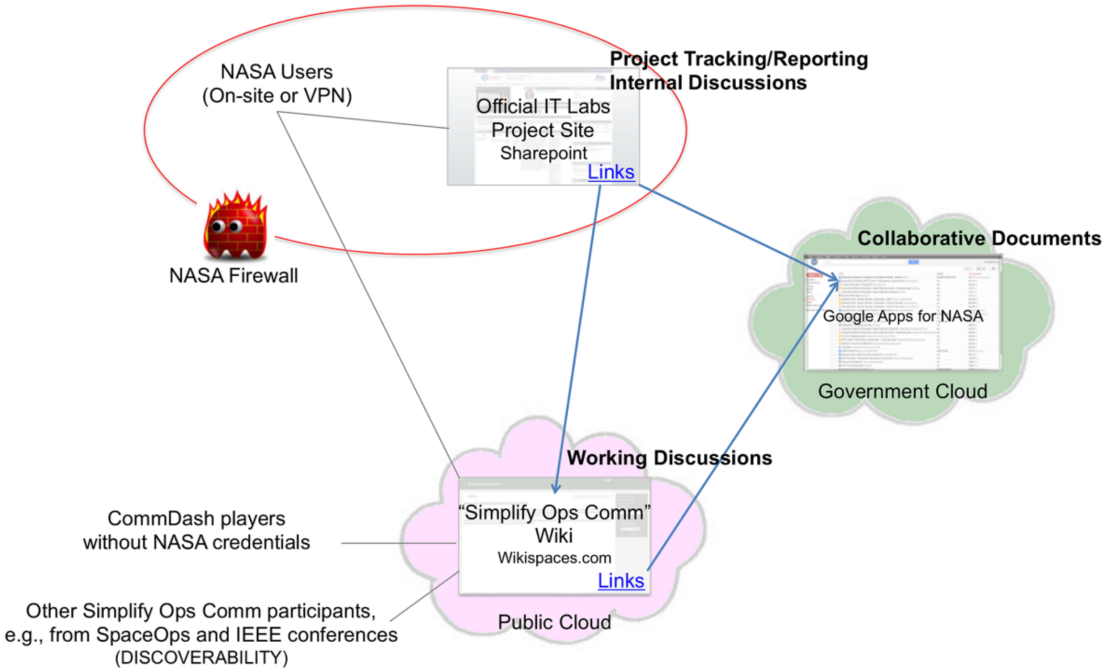

Figure 2 – Collaboration Paths

4. SOCIAL MEDIA UNDERPINNINGS

For several years, social media carried a connotation of mere recreational friendship. As blogs and SNSs have become more common in offices, this negative image has diminished somewhat. If we define "social" as "interactions among organisms and their systems," it's logical that the engineering and operations world would pay as much attention to social interfaces among humans as we pay to those among our electronic systems. Figure 3, which was adapted from presentation charts related to earlier papers [1] and [2], reviews some social media *principles*, *behaviors, and potentials* that relate particularly well to CommDash.

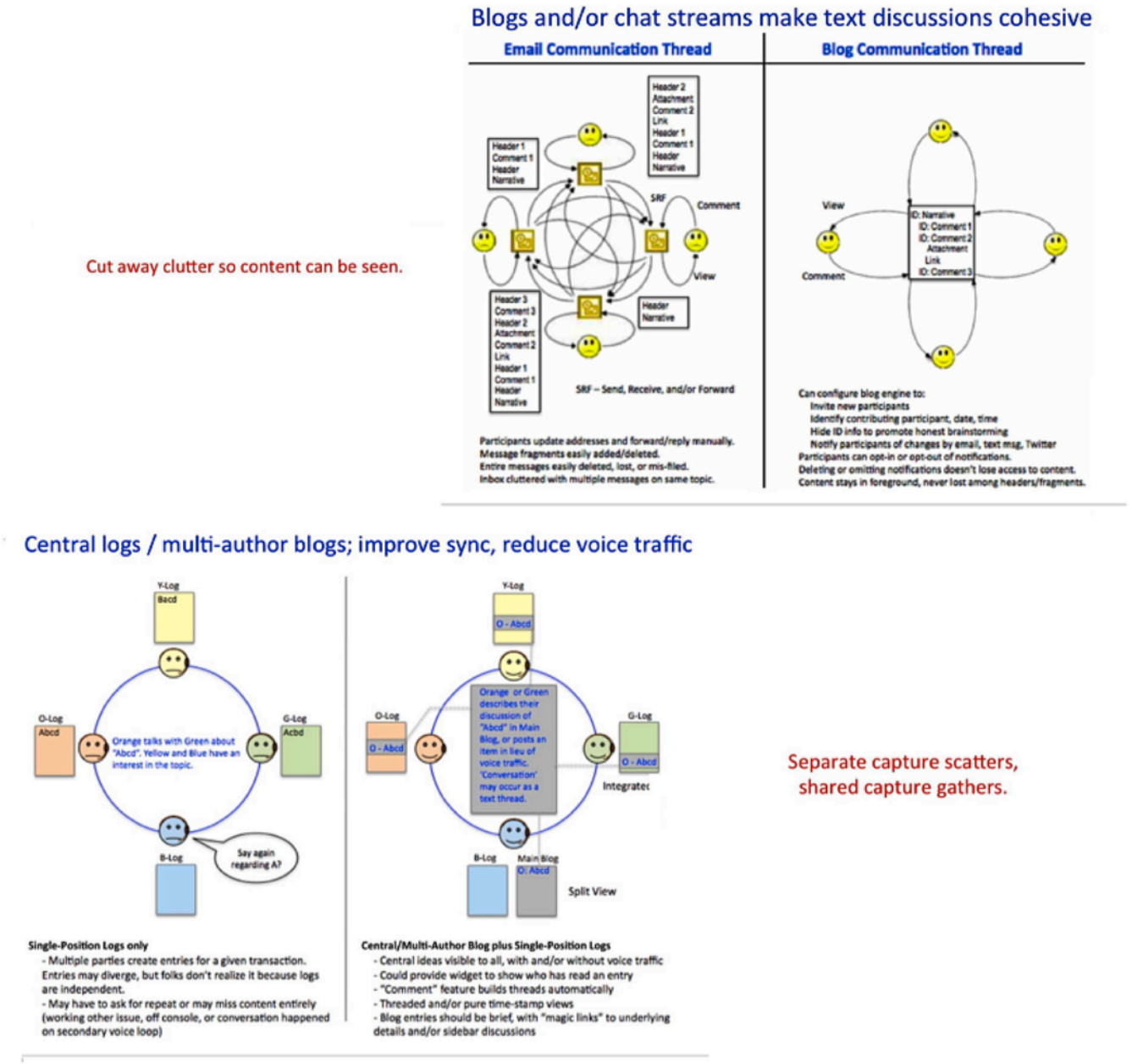

Figure 3 – Some Operations-Relevant Social Media Functional Characteristics and Behaviors

5. Critical Concept – Visual Persistence

When the space program began, voice communication was much easier to create and transmit than text or graphics – we were using paper, pencils/pens, and typewriters! While computers sped up the business of creating text and graphics decades ago, developments in the last few years have enabled text and graphics to become nearly self-managing, making them easier to manage and follow than voice CommDash relies heavily on the principles illustrated in Figure 4.

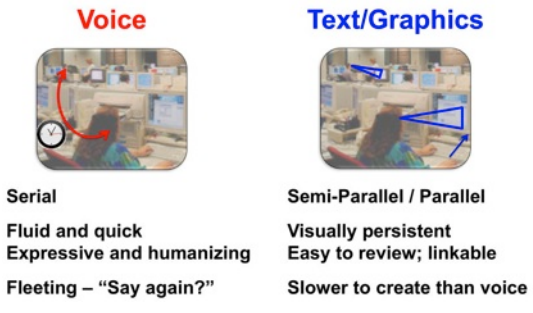

Figure 4 – Comparative Characteristics of Voice and Text/Graphics

6. COMMUNICATIONS DASHBOARD OVERVIEW

Since a Social Networking Service (SNS) approach has been chosen as the basis for CommDash and since most people with internet access are at least familiar with a leading SNS such as Facebook® or LinkedIn®, perhaps the easiest way to describe CommDash's intended functionality is via the visual mockup shown in Figure 5.

Note – This discussion assumes that he reader is familiar with ISS Operations Protocol and/or aviation voice protocol, e.g., standard phrasing conventions for verbal and written communications in the real time flight control environment. Translations of acronyms referring to flight controller positions, systems, payloads, and statuses are generally not given, as they are not central to how the components work.

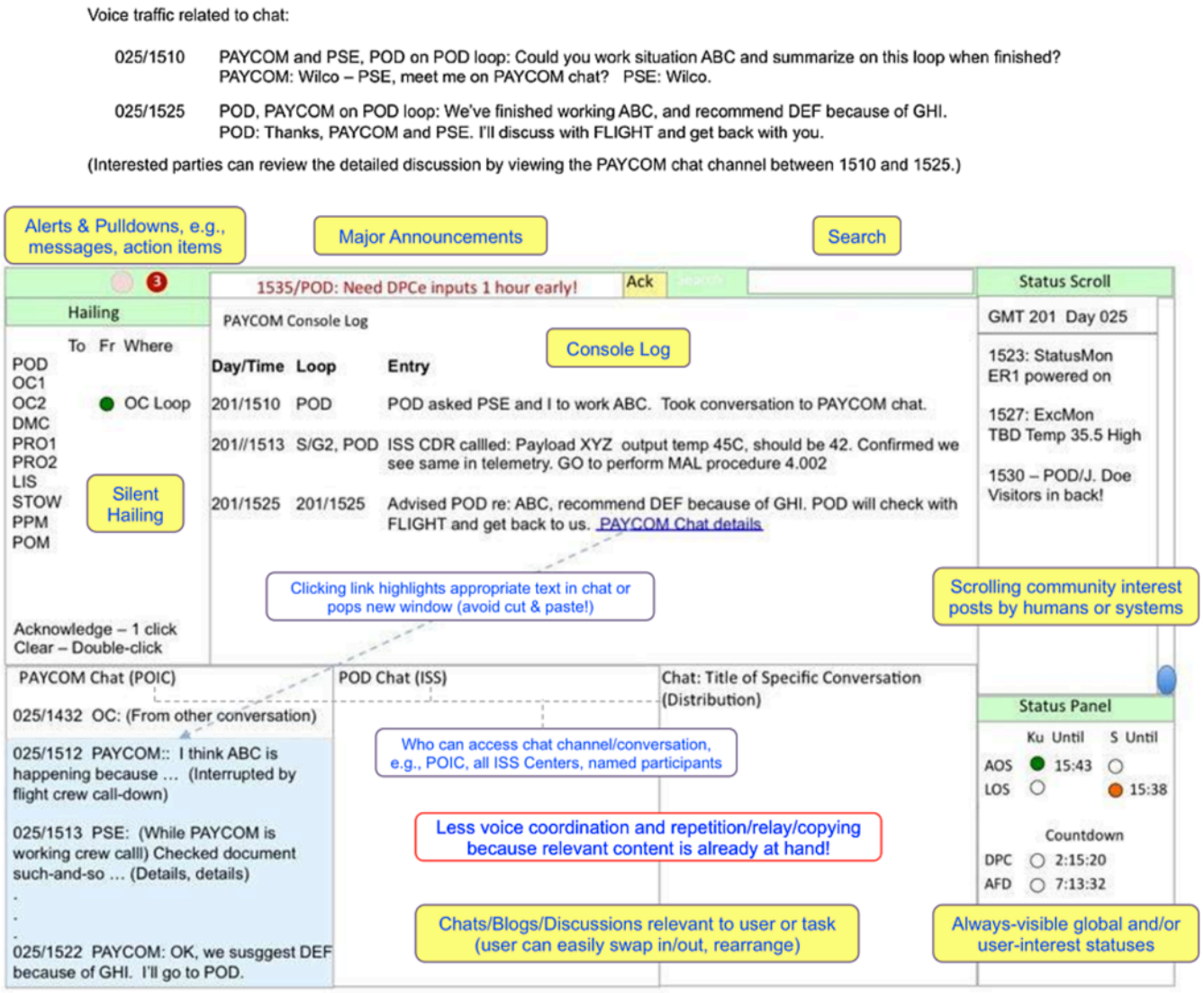

Figure 5 – Communications Dashboard Mockup Based on ISS Payload Operations at POIC

7. TECHNICAL PROGRESS TO DATE

Figure 6 shows a first-cut breakdown of information stream sources and likely integration functions that CommDash would need to provide.

There have been preliminary discussions with a few COTS vendors, and some of their product features have provided food for thought.

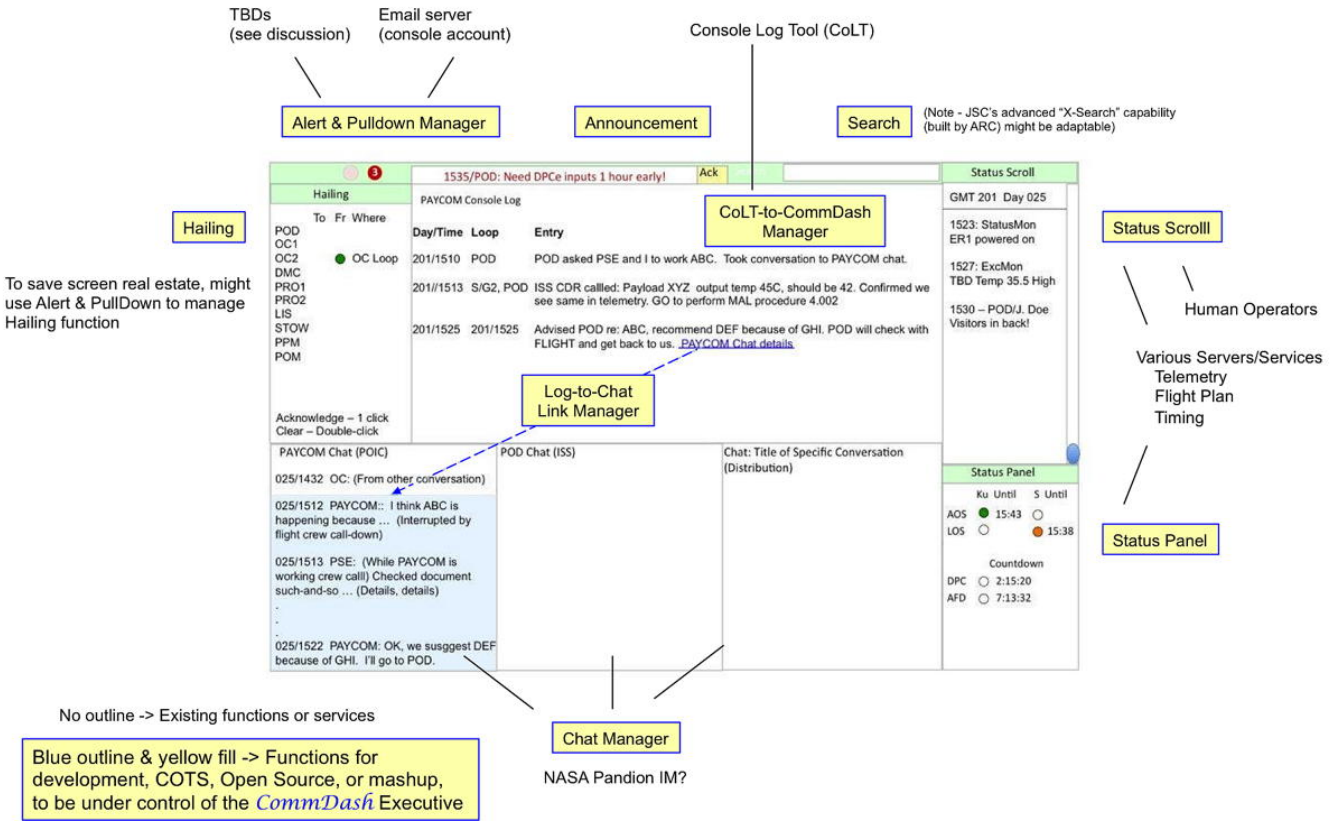

FIGURE 6 – PRELIMINARY BREAKOUT OF COMMDASH FUNCTIONS

To be effective in an operations environment, CommDash should have some unique features compared to most of today's SNS environments:

- Resize individual frames, perhaps by dragging borders
- Rearrange relative location of frames (some SNSs allow this, but with significant restrictions)
- View multiple chat streams concurrently
- Swap out chat streams very quickly and simply
- Create dedicated chat streams on-the-fly, e.g., for a specific discussion (as opposed to a stream analogous to a given voice loop)
- Dynamically manage chat streams, e.g., restrict access, lock a stream temporarily or permanently
- Index streams, e.g., list in a filterable table of contents similar in appearance to email environments

Candidate Alert & Pulldown functions (analogous to Facebook® Friend Request, Messages, and Notifications alerts) might include console e-mail account access, individual company e-mail account access, hailing, user-defined notifications/reminders, etc.

User interface design merits extremely careful thought and consideration.

8. CONCLUSION

The author has used this Idea/Issue phase to assemble a team representing multiple control center interests at NASA and to gather preliminary inputs from government and industry on existing tools that might be brought to bear.

Current state-of-the-industry technology appears to be sufficient to build the target environment. Innovation will lie in the way that the pieces are assembled.

The author will apply to NASA IT Labs for a follow-on Proof of Concept phase to define underlying detail and test some components sufficiently to justify proceeding to the Prototype phase, with MSFC's POIC being the target environment. By accounting for interests across the agency up front, it should be possible to design and build a robust testbed and/or prototype that could be easily refined and adapted to other control centers, NASA functions, and/or industries.

A collaborative environment that is discoverable by anyone and that allows in-depth browsing and contributions by approved contributors is invaluable for a) involving a broad spectrum of participants across government, academia, and industry and b) minimizing redundancy. The resulting team may be useful for pursuits beyond the original project.

It's worth noting that JSC is working on a demonstration of text chat capability between ISS and the ground. The CommDash team hopes that we might join forces at an appropriate time.

The one-minute "elevator pitch" video required as part of the IT Labs application process was extremely valuable. The video itself concisely defined and illustrated the proposal, while the effort to create the video focused the author! This would be a good exercise for a wide variety of proposal efforts.

While CommDash has been conceived with mission operations in mind, a very similar treatment could be quite effective for mission support and/or large scale design projects… Space Launch System, perhaps?

If all goes well, Chapters 2 and perhaps 3 of this effort will appear at future conferences. Feel free to contact the author and join the team!

REFERENCES

[1] **Scott, David W., "Using Social Media in Engineering Support and Space Flight Operations Control", 2011 IEEE AerospaceConference, http://ieeexplore.ieee.org/xpl/articleDetails.jsp?arnumber=5747662**

[2] Scott, David W., Cowart, Hugh S., Stevens, Daniel J, "Simplify ISS Flight Control Communications and Log Keeping via Social Tools and Techniques", SpaceOps 2012, 1276528, http://www.spaceops2012.org/proceedings/documents/id1276528-Paper-006.pdf

BIOGRAPHY

David W. Scott, *alias "Scotty", is currently developing innovative interfaces and applications for the Huntsville Operations Support Center (HOSC) at NASA's Marshall Space Flight Center in support of ISS payload operations. He was a Payload Communications Manager for the International Space Station from 1999-2007. He has spearheaded several console technology projects, especially in space-to-ground videoconferencing and audio archiving. He was a payload communicator for the ATLAS-1 Spacelab mission in 1992, and helped design the payload training program for Space Station. He spent 6 years as a U.S. Naval Officer, including flight duty in F-14s, and holds a B.S. in Physics and Mathematics from Principia College.*